DOCUMENT RESUME

ED 064 452 UD 012 803

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TITLE Ability of Ghetto Children to Retain Images Related to Learning. Final Report.
INSTITUTION Georgia Univ., Athens.
SPONS AGENCY Office of Education (DHEW), Washington, D.C. Bureau of Research.
BUREAU NO BR-9-D-023
PUB DATE 1 May 72
GRANT OEG-4-9-200023-0060-057
NOTE 50p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Academic Achievement; *Concept Formation; *Conceptual Schemes; Cultural Disadvantagement; Culturally Disadvantaged; Disadvantaged Environment; Disadvantaged Youth; Educationally Disadvantaged; Fundamental Concepts; Generalization; *Learning; Learning Activities; Learning Processes; *Learning Theories; *Preschool Children; Social Disadvantagement; Thought Processes

ABSTRACT

Piaget's notions about schema retention were examined using a sample of 384 disadvantaged four, five, and six year old children from a wide geographical area. The purpose was to examine the idea that schemas may be destroyed or modified by specific methods of interference using a retroactive inhibition model. Pictorial scenes were generated and shown to the children individually until a schema was formulated. These scenes were then removed, modified, and represented to check for schematic retention. Retention was tested by recall recognition. Temporal sequencing caused schematic loss. Irrelevant interferences produced the least amount of schematic loss. Both recalled and recognized schemas showed little effect of the interferences. Since all interferences were systematic modifications of the original scenes, when S realized he was being presented a set of scenes, he substituted an anchor schema for the original. This anchored schema became the new schema, and the original schema was generally lost. Analyses indicated that children of this population may be less subject to losing schemas as to having them systematically modified by interferences which supplant the original schema. (Author)

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Author's Abstract

Piaget's notions about schema retention were examined using a sample of 384 disadvantaged four, five, and six year old children from a wide geographical area. The purpose was to examine the idea that schemas may be destroyed or modified by specific methods of interference using a retroactive inhibition model. Pictorial scenes were generated and shown to the children individually until a schema was formulated. These scenes were then removed, modified and represented to check for schematic retention. Methods of modification of the original scene included temporal sequencing, adding cues, removing cues, and interfering with irrelevant pictorial scenes. Retention was tested by recall or recognition. Temporal sequencing caused schematic loss such that the original schema was replaced by a similar schema removed in time, an apparent temporal response set. Irrelevant interferences produced the least amount of schematic loss and both recalled and recognized schemas showed little effect of the interferences. Since all interferences were systematic modifications of the original scenes, when S realized he was being presented a set of scenes, he substituted an anchor schema for the original. This anchored schema became the new schema, and the original schema was generally lost. Analyses indicated that children of this population may be less subject to losing schemas as to having them systematically modified by interferences which supplant the original schema.

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May 1, 1972

The research reported herein was performed pursuant to a grant with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official office of Education position or policy.

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UD 012803

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Table of Contents

Topic		Page
Chapter 1	Introduction	1
Chapter 2	Review of Literature	5
Chapter 3	Methodology	8
Chapter 4	Results	13
Chapter 5	Conclusions	17
Selected Bibliography		20
Appendix A	Tables 1 through 10	A-1
Appendix B	Plates	
	Original pictorial scenes	B-1
	Examplar modifications	B-6

CHAPTER I

The Problem and the Hypotheses

Because of the increased reliance upon the developmental psychology devised by Jean Piaget, and because of the increased quantities of funds, both public and private expended on Piagetian-oriented programs, the need to investigate empirically at least some of these developmental building blocks becomes imperative.

The Problem

Piaget has formulated theories which attempt to delineate stages in cognitive evolution from the motoric stages of infancy to the abstract, logical thinking of adult life. He organizes the years of development into three periods (Inhelder and Piaget, 1958): (1) the sensorimotor period from birth to two years of age; (2) the preparation for and organization of concrete operations which occurs between the ages of two and eleven years; and (3) the formal operations period from ages eleven to fifteen. The middle period is further subdivided into two sub-periods: the period of preoperational representatives from ages two to seven, and the period of concrete operations from ages seven to eleven. The focus of the present study is concerned only with the period of preoperational representatives. Two specific foci are under consideration concerning the child of the preoperational period. First, Piagetian rationale holds that the preoperational child perceives his immediate environment but cannot conceptually conserve a mental image of it. He can report what he perceives but does not integrate his perception into a conception, into a construct; and as this perception moves from his immediate field, it becomes, to a greater or lesser extent, lost as an apparent schema, or as an anchoring point for subsequent schema-building. Langer (1969) views the mental operations of the preoperational child as being determined by his own present action and as being tied to perceptual experience without transformation. He (Langer) suspects that the child understands the relations between static events in terms of their phenomenal configurations rather than by the transformations that must have transpired (p.138). The preoperational child may recognize that transformations have taken place, but he assimilates them to his own actions and not as yet to concrete operations (Inhelder and Piaget, 1958).

Very briefly, what these theorists are suggesting is that the preoperational child's cognitive schemas are incomplete and that he is therefore unable to operate on a conceptual plane. Whether these suggestions are to any great extent representative of the actual state of the child's cognitive development remains to be determined by empirical investigation.

A second focus of the current investigation is also concerned with schematic conservation; however, the immediate question centers about the way in which an individual of the preoperational level is tested for his conceptualizations. It is suggested that a perception, originally thought of as a schema, may be lost when removed or modified, but this same perception may be recognized more readily if presented again than if the subject were asked to recall the perception via mental image, i.e., by conserving the perception in some hypothesized conceptual storehouse. It is further suggested that this schematic or subschematic loss is less a function of nonrelevant interference than of retroactive inhibition due to successive modifications of the original perception. These two foci are related both conceptually and psychologically. Both deal with conservation, both deal with the constructs of assimilation and accommodation, both are concerned with the effects of modification of stimuli as these relate to the ability of the preoperational child to communicate a schema. Because the building of constructs or schemas through assimilation, accommodation, and conservation is a currently popular model by which we educate children, a closer look at these concepts is in order.

Piaget (1952b) reasons that each cognitive advancement must represent an advance in understanding made possible by experience. As understanding involves internalization of experience or mental images, Piaget calls these images "schemas". He holds that the infant begins life with only simple reflex schema, i.e., sucking and grasping, which become progressively modified by assimilation of experience. The change in schema resulting from assimilation he refers to as accommodation. This change is a gradual process of adaptation and is rather slight at any one time; that is to say that not all aspects of the environment which could be accommodated or assimilated at a given time actually are. The individual will take in only those elements of reality which its current structure can assimilate without great change. Hurlock (1956, p.374) refers to concepts as being cumulative. What he is saying is that in the development of concepts, the child builds new meanings on old ones. The individual can assimilate only those aspects of reality which fit the pattern of his ongoing structure (Flavell,1963, p.48).

Every cognitive meeting with the environment must of necessity involve some sort of structuring or restructuring of that environment in accord with the system of the individual's existing cognitive organization. This implies that there has to be a system of meanings already part of the cognitive processes, and advanced enough so that, if necessary, it can be modified to allow those objects of the environment to be admitted for assimilation that accommodation sets before it. Kelly (1955) has worked with this idea in his theory of personal constructs. Both Kelly and Piaget suggest that an individual's cognitive system will not tolerate completely new schemas or constructs, that accommodation and assimilation balk at happenings that require a completely new interpretation or structuring. Kelly refers to this process as the scientific approach of testing all constructs in a microcosm. He suggests that basic constructs (Piaget's schemas) are essential to normal operations and that successive modifications of constructs are necessary to keep the individual in some sort of congruence with reality. Without the constructs, the organism is disoriented and anxious, and thus will structure a universe wherein his egocentric or poorly formulated constructs can be made operational (a condition not unlike the psychological disorientation referred to as schizophrenia). Piaget (1954) suggests relative to the nature of learning in children:

> assimilation is by its very nature conservative in the sense that its primary function is to make the unfamiliar familiar, to reduce the new to old (p.352).

Piaget (1952b, p.410) holds assimilation to be the main component of intelligence, maintaining that assimilation creates schemas, which in turn maintain themselves through assimilatory functioning. Early assimilations and accommodations of the child can interfere with those of the present only when the child has developed enough to be able to create schemas and conserve them. In the very young child, assimilation and accommodation are always in the present. The child of the preoperational period not only has to assimilate and accommodate objects in the present perceptual field, but also he has to begin to go even further by tying these present data to perceptually events, i.e., to non-present significates. His accommodation takes place through a mental image. These mental images provide the crux for the present investigation.

Piaget holds that a mental image does not exist until

and unless the individual can distinguish the image from a perception: the image must be something constructed by the child; the perception is essentially environmentally related. The image is a schema in Piaget's terms, a construct in Kelly's terms, and implies internal activity rather than external activity (Baldwin, p.225). The assumption here is that a child who is operating on a conceptual plane (as opposed to a preconceptual plane) will be able to integrate two temporally separate experiences into a single judgment. The preconceptual level child is held to be dependent on perception, and this dependence limits the child's abilities to successfully achieve the integration. The very young child's problem hinges on his lack of success in integrating information from past experiences on perceptions so as to reach correct judgments. In Vygotsky's (1962, p.66) studies on the developmental phases of concept formation, he concludes that the preconceptual level child is capable of recognizing a double dichotomy of attributes only by visuable likenesses, and his judgment is tied to perceptual bonds. Inhelder (1965) suggests that the mental imagerry of the preconceptual level child is limited to copying, or to imitating in a schematic way, the object of his knowledge.

Flavell (1963, p.162) describes the preoperational child as one who thinks in staid terms, as being taken up more with the immobile eye-catching configurations of a stimulus. The child sees the immediate, one thing at a time with only vague ideas as to the existence of other nearby perceptions. He apparently doesn't differentiate among members of a perceptual class. In an invariance problem he centers first on the present situation, then goes on to center on another phase or part of the situation so that data from other phases (or the total configuration) are not brought into the conceptual field. The preoperational centering allows the child to focus only on the perception before him. Perceptual experiments involving mental imagery can help to bring about success in subschematic tasks; however, when tasks increase in complexity, the development of schemas, a function of the decentered child, is necessary for success.

Since the bulk of the research based in Piagetian theory has implications for the education of young children either in terms of curriculum content or in terms of teaching strategy, it becomes imperative to test the assumptions upon which this Piagetian thinking rests. For example, does a very young child recognize a previously acquired stimulus (schema) when this stimu-

lus is re-presented? Can he recall the original schema after some interference has taken place? The present study makes an attempt to investigate these questions with the expectation that the results of experimentation will provide some insights into Piagetian theory, and consequently, into the concept development of young children, all of which should produce some definable application to education.

CHAPTER 2

The review of the literature

Since Piaget's basic theories of the preoperational child's ability to build schemas through assimilation, accommodation, and conservation are basic to the foundations underlying the present study, it is important to recognize the research developed in these areas.

Supportive evidence

Piaget recognizes successive stages in the development of concepts and assigns approximate ages to the stages of development (Inhelder and Piaget, 1958). His sequence of cognitive development has been verified in part by the research on cause-and-effect (Deutsche, 1937; Vinacke, 1951) and sequence in development of number concepts (Douglass, 1925; Long and Welch, 1941; Ilg and Amos, 1951). Kofsky (1966) tested the aspects of Piaget's theory of development of classificatory rules; that is, on acquiring a particular classificatory rule the learner should also have acquired all the prerequisite rules. Eleven tasks were administered to a sample of 122 children between the ages of four and nine years old. It was concluded that a discrimination of .9 was suggestive of regular stages in the development of categorizing skills. This formulation corresponds essentially to the theory by Piaget that conceptual development advances in evolutionary stages directly related to the increase in age.

Some emphasis must be given to the investigation of schema building through assimilation, accommodation, and conservation in the preoperational stage. Piaget maintains that because in the preoperational stage the child has not assimilated and accommodated experiences

necessary for the understanding of conservation, he cannot conceptually conserve a mental image (schema). This theory is based upon numerous studies concerning the ontogeny of logical operations which depend upon the relationship of numbers, space, time, substance, weight, and volume (Piaget and Inhelder, 1941; Piaget and Inhelder, 1956; Piaget and Szeminska, 1941).

The appearance of the operations concerning spatial relationships are revealed in Piaget's studies by changes at approximately the age of seven years, in that the child becomes capable for the first time in performing tasks supposedly demanding conservation of geometric properties and the conception of spatial relations (Piaget and Inhelder, 1956). In two experiments by Piaget (Piaget et al.,1948; Piaget, 1946) the subjects, ages four to eight years, were required to move a bead along a wire the same distance demonstrated by the examiner with an identical bead along another wire which followed a different course in relation to direction or starting position. Not until after age seven years were the subjects able to measure accurately. Inhelder (1965) supported Piaget's findings in an experiment in which children were presented a piece of wire shaped in an arc and requested to draw another piece of wire that would show the length of the curved wire if it were straightened out and to draw the stages of the transformation. Not until the children had reached the concrete operations stage (seven to ten years) were they able to imagine the transformations accurately.

Similar support of Piaget's theory that the preoperational child cannot conceptually conserve a mental image (schema) has been offered by the study of Piaget and Inhelder (1962), concerning the development of quantity conservation. Piaget and Inhelder concluded on the basis of their many experiments that discoveries of conservation followed a regular order that was related to age. The conservation of mass was discovered at ages seven and eight; the conservation of weight was discovered at the ages of nine and ten; the conservation of volume was discovered at the ages of eleven and twelve. Piaget found that the preoperational child was not able to attest to the invariance of matter after transformations. Other investigations have confirmed Piaget's findings (Elkind, 1961; Carpenter, 1955; Inhelder and Sinclair, 1967).

Furthermore, Piaget (1952) holds that the preoperational child has not yet attained the invariant concept of numbers, and that number concept development is directly related to the attainment of conserva-

tion of quantity, since the understanding of quantities (numbers) is possible only with the understanding of wholes (conservation). Recent empirical work has given support to the notion that the attainment of the level of conservation is directly related to the formation of the number concept (Dodwell, 1960; Wohlwill, 1960). Piaget (1952) demonstrates that the child's conception of numbers begins as an intuition of whether there is more or less in one configuration than in the other, and that reasoning is based upon the arrangement rather than the amount of the items considered, thatis, upon the concrete phenomenal quality of the configuration rather than upon conservation of the number after transformation. Other investigators have confirmed his theory (Wallach and Sprott, 1964).

Negative evidence

The validity of the methodology employed by Piaget in testing conservation has been questioned by several investigators (Fraisse and Vautry, 1952; Braine, 1959; Braine and Shanks, 1965a,1965b). These investigators have discovered different age norms and performance behaviors for similar tasks and subject populations using different task requirements and explanatory processes. Gruen (1966) reports that Braine and Shanks find that children four and five years old are able to conserve, and similarly, Frank (in Bruner, 1964) found that five year old children have the ability to conserve. Gruen concludes in his study that differences in task requirements and explanatory processes produce different age norms as well as a different theoretical framework upon which the definition of conservation and the concepts of conservation-behavior rest.

Furthermore, some emphasis must be given to the validity of the population generalizability of Piaget's findings. In studies by Piaget (1946, 1952a, 1952b, 1956, 1962) and his supporters (Carpenter, 1955; Wohlwill, 1960; Kofsky, 1966; Inhelder and Sinclair, 1967; Hooper, 1968), the samples are confined to white middle-class American and European children, and the validity of generalizing the findings to the population of all classes of children and all cultures is, at best, questionable. How children of different cultural and social class backgrounds perform on Piagetian tasks (quantity, classification) has to some extent been investigated (Hyde, 1959; Goodnow, 1962; Price-

Williams, 1962; Bruner, Olver, and Greenfield, 1966; Almy, Chittenden, and Miller, 1966). Even though some universal commonalities in developmental trends have been discovered, it has also been reported that cultural and class differences are relevant psychological variables in conservation tasks (Goodnow, 1962; Almy, Chittenden, and Miller, 1966; Bruner, Olver, and Greenfield, 1966; Mermelstein and Shelman, 1967). Further investigations on the concepts of conservation are needed using samples of different cultures and/or social classes, different, that is, from the traditionally sampled white middle-class American and European children.

CHAPTER 3

Methodology

The sample. The sample was comprised of 384 children aged four, five, and six years; one half of the group was black, one half white. All children could meet the generally accepted criteria which would categorize the lower classes of our society. Every child came from an area or neighborhood where poverty conditions tend to regenerate poverty conditions. The sample was chosen entirely from the eastern coastal United States with the geographical limits extending from upper New York State to Georgia.

Subjects were chosen from population centers which could produce sufficient numbers of target children in institutionalized settings, e.g., Headstart, Homestart, day care centers, public schools, etc. Choice was based more on the availability of subpopulations of subjects than on any rigorous attempt to select by random procedure from some well-defined subject population. This, of course, presents some problems in the eventual generalizability of any results forthcoming from the study. It is maintained that this generalizability restriction is less damaging in an exploratory study of this nature than would be the case in a more rigorous and tightly controlled follow-up of any useful indications suggested by the final analysis of the data. Precluded from the study were any children who manifested any of the classical symptoms of emotional disturbance.

The design. The originally conceived design was a 4x2x3x2 experimental design with four methods of

stimulus modification, two methods of determining success, three age groups, and two racial groups. Eight Ss were planned for each cell. Many factors, sampling realities, economics, time, operated against this design such that a compromise was mandated. The final design was still of the same cast as the original, but changed enough to prevent analysis by the desired four way analysis of variance model. Instead of one rather grand scale experiment, four lesser experiments were developed, not totally independent of each other, but resulting in the situation where the results of each subexperiment were not directly comparable to each other, at least not without making some assumptions that might be a bit hard to live with.

These compromise designs are as follows:

1. age four years: A sample of 64 black Ss and another sample of 64 white Ss were drawn, a total of 128 Ss, all from Headstart programs. Approximately one half the blacks and one half the whites were from metropolitan southern areas. The remainder of the blacks and whites were drawn from urban centers in the northeastern United States. In this age group data were analyzed nonparametrically using the chi square technique. Data were analyzed separately for black and for white groups. The contingency tables contained data for methods of interference and for success criteria.
2. age five years: Samples of 64 black Ss and 64 white Ss were drawn, mostly from metropolitan southern schools. All Ss were involved in Headstart programs within 100 miles of the metropolitan Atlanta area. No Ss were selected from the northern or northeastern regions of the United States. Approximately one fourth of this group came from rural poverty areas which met the original criteria for being a poverty regenerating area. Data from this subsample were analyzed using an analysis of variance model with method of interference, success criteria, and race as the factors to be examined.
3. age six years: A sample of 64 blacks was selected from urban schools in the South. Some of these were in Headstart programs; some were in first grade in public schools. Data from this sample were analyzed in a method of interference by success criteria (4x2) analysis of variance procedure. A second sample of 64 white Ss was drawn, half from northern schools, half from southern schools. These Ss were also drawn from Headstart

programs and from the public schools. Data from these Ss were analyzed using the same procedure as with the black group.

The variables. Four methods of introducing interference were defined: (1) sequential, (2) additive, (3) reductive, and (4) irrelevant. The sequential interference worked as follows. A simple line drawing of a scene was produced for S. The drawing was of the nature wherein the number and variety of cues were minimal, yet the action was identifiable and determinable as to being within the experience of all Ss used. For example, the first scene presented to each S showed a man standing at a bus stop waiting for a bus. There is a dog sitting next to him; the sun is shining; the birds are flying overhead; the approaching bus is in plain view. If S could not identify what was happening in the picture, he was not used. No S had any trouble with this identification: it was readily recognizable to all. The drawing was then removed and S was asked to tell what he had just seen. If he omitted details, the scene was re-presented until he had the entire scene in detail firmly in mind. Then a modification of this scene was presented to S. The first modification involved the man flagging the bus. The bus was closer, and the only essential change was one of time lapse: the same man, the same dog, the same bus stop, the same bus, but all set a few moments later in time. The next modification showed the man entering the bus, again with the only substantial change being that of time. The final modification shows the man departing in the bus with the dog running after the bus. Then the original frame is presented again to S.

In the additive modification procedure, the same original frame was utilized, but the interferences were of a different nature. In the bus scene, frame two differed from frame one only in the addition of a building; to this in frame three was added a flag on top of the building; then a fire hydrant was added. Again frames one and five were identical, with the frames two, three, and four serving as retroactive inhibitors.

In the reductive treatment, the original frame was changed by successively removing (1) the bus, (2) the sun, and (3) the bus stop sign.

The final treatment, the irrelevant interferences, involved the use of nonrelevant interfering frames. As an example of this type of frame, one set produced for identification a bell, a kite, a raccoon, a butterfly, a flag. This was followed by another frame

containing a deer, baloons, a rocket, a horn, and a flashlight. The third interfering frame contained a picture, a can, a sailboat, a boot, and a rake.

Five sets of stimulus materials were developed in this fashion. These included the bus set described above, a set with a boy fishing, a scene in a playground, a set depicting a motorcycle passing a car which is having a tire blowout, and one showing a young girl waking up from sleep. Each set had sequential, additive, reductive, and irrelevant frames analogous to those of the bus set.

Two means were employed to determine whether the modifications brought about changes in the child's conceptualization of the original scene: recognition and recall. The child was considered successful if he recognized the representation of the original scene as the original scene and could communicate this recognition; he was considered unsuccessful if he merely described the scene without noting the identity, or if he described it in terms of a modification of some other frame than the original. Under condition of recall he was required to recall the original frame without introducing any of the elements contained in the interfering frames.

The term "anchor" was introduced to describe that frame in which the child could first be adjudged to be aware that each of the frames formed a set and were not just random scenes for him to describe. If the child communicated that frame two was in some way related to frame one, then frame one was held to be the point at which he anchored his judgments and conceptualizations of the set. If he never communicated his awareness of the relatedness of the frames in the set, he was adjudged not to have anchored, or as being unaware of the desirability of communicating his conception, which for the purposes of this study amounted to the same thing. In the case of such a failure, S was considered to be perceiving, not conceiving.

Latency measure were taken on the six year old group. Latency was taken to be time to response on the re-presentation of the stimulus, in seconds. No latency measures were taken on the four and five year olds because in pilot studies it was determined that with young group the latencies were of such a nature quantitatively as to be uninterpretable.

The task. Each child was given five sets of stimulus materials in one combination only. The child subjected to the sequential treatment was not given the additive, reductive, or the irrelevant sets.

Each child was required to recall or recognize, but not both. The presentation of the task was put forth to the child as a game, one in which the child was to pit his wits against the examiner's. Each examiner admonished each child that he was going to play a game with him with some pictures and challenged the child with claims such as, "I'm going to play a trick on you, and you won't even know when I do it". The tactic had worked with other groups as a motivator and as a sensitizor.

Each child was worked with individually. He was shown frame one of a set first, asked to describe it, tell what was going on, and generally develop an idea of the scene. Then the frame was removed and the examiner asked the child to retell what the scene was, in detail. If the child erred, or if he added or omitted details, the scene was re-presented and the procedure repeated until the child responded with complete accuracy. Then the frame was removed and replaced with frame two. The child was asked to tell what was going on or to describe the frame. Whatever description he gave was accepted just as if it were completely accurate and contained optimal information. This frame was then removed and replaced with the next frame, and finally with frame four. After these three interfering frames were described by the child, frame one was again presented, or as in the case of recall, S was asked to recall frame one. His ability to recall or to recognize frame one was taken as evidence that he had conserved the schema and was not operating completely in the area of perception. Any attempts by the child which contained elements of one of the successive frames (frames two, three, or four) was taken as evidence that his original schema had been interfered with in a retroactive inhibition sense, and that the original schema had not been conserved, at least not in its original form. This process was repeated four more times with the four succeeding sets, and records of each child's responses were kept.

Scoring for anchor. Ss were given a score of one through five determined by the frame in which they anchored their responses. If S recognized frame two as a modification of frame one, then he anchored in frame one and was consequently scored a one. Thus, recognition in frame three of the stimulus materials as constituting a set would imply an anchor in frame two, and so on to the final frame. Failure to recognize that the stimulus materials represented a complete set indicated that the child was operating in the percep-

tual mode and had not anchored or formed a concept. He would then be scored a five.

CHAPTER 4

The Results

There were two general considerations which were subjected to analysis. The first concern was with the two methods of identifying the conservation of a mental image: recall and recognition. The second concern was with the differential effects of the four means of introducing retroactive inhibition on the conservation of these images (schemas). The quantitative results of the analyses follow.

Six year olds. The F ratio computed for the four means of introducing retroactive inhibition for both black and white groups was significant for both the black and the white groups. The computed mean for the irrelevant treatments was in both cases significantly higher (indicating more successes) than the computed means for any of the other methods of interference. These findings support the idea that schematic loss is not so much a function of nonrelevant interfering as of retroactive inhibition due to successively modifying the original stimulus. The groups scored higher numbers of successes in the reductive treatments than in the additive treatments. In the additive treatments, the task not only required S to remember the original stimulus, but also to perceive relevant other information introduced into each successive modification. In the reductive treatments the task required the child to remember the original stimulus, but the factor of selectivity was different in that the appropriate cue was deducted from each successive frame rather than added to it. That this differential selectivity is psychologically meaningful is suggested by Wohlwill who claims that the underlying dimension of selectivity is a factor which distinguishes a perceptual from an inferential task, and that as one proceeds from perception to conception, the amount of irrelevant information that can be tolerated without affecting the response increases.

The F ratios computed for the two methods of identifying the conservation of a schema were significant

for both groups; these ratios were 4.68 and 5.95 for black and white samples resrectively. With both samples the recall condition produced more successes than did the recognition condition; i.e., the child was able to recall better the exact original stimulus than he was able to recognize it after interference.

The interaction of the modifications with the methods of identifying the schema produced significant information. Both black and white groups yielded interaction mean squares that were significant at the .05 level. The expectation was that the perception might be lost when modified, and that this same perception might be recognized more readily if presented again than if the subject were asked to recall the perception via mental image. Examination of the table of interactions indicated that the effect of introducing retroactive inhibition was the greatest for the the recognition method under all types of modification except the irrelevant modification. These findings, contrary to expectation, indicated that a perception is more readily recalled than recognized; however, in examining the irrelevant treatments, the effects of interferences was minimal in the recognition treatment, and the irrelevant recognition treatment produced more successes than any other combination. This interaction may be the result of the differing procedures used. Under conditions of recall, when first shown the original stimulus the samples were told that they should remember the stimulus with the implication that they would be asked to recall it later. In the recognition condition, even though the attempt was made to present the task in a nearly identical manner, phraseology may have served as a sensitizing catalyst. The procedures may have differed just enough to have given the S in the recall condition a cue to be selective of the relevancy of the information in the succeeding stimulus modifications without offering the S in the recognition condition the same cue. Relevancy cueing of this nature would affect only those treatments in which the means of introducing retroactive inhibition were relevant to the schema. With this view in mind, the higher number of successes in the irrelevant recognition treatment than in the irrelevant recall treatment may be attributed to the original view that a perception may be recognized more readily if presented again than if the subject is asked to recall it through some mental image.

The results of the analysis of variance for comparing successes are shown in Tables 1 and 2, shown on page 1 of Appendix A.

Analysis of the variance of the means for the three means of introducing retroactive inhibition to the two

samples were indictive that the type of interference is a significant factor in examining concept information. Only three or four types of interferences were examined because it was held that to look for an anchor in the irrelevant condition would be fruitless, and any data of this nature obtained would be uninterpretable and totally meaningless. Clearly, the irrelevant interferences were not modifications of the original stimulus. The computed means for the three modifications examined, in order of absolute magnitude were (1) reductive, (2) additive, and (3) temporal sequencing. This ordering signifies that anchoring took place later in the reductive treatments than in the additive treatments; later in the additive treatments than in the temporally sequenced sets.

When the two methods of identifying whether a concept or a schema had been retained were examined, a consistant finding obtained for the two samples. In each case it was found that anchoring took place later in the recall condition than in the recognition condition. This result is suggestive of some extraschematic interference rather than of some bona fide difference in the two methods, because the two procedures were identical in presentation until the last frame of the task.

Significant interaction variation indicated that the anchoring results were not attributable completely to main effects. Analysis of the interaction tables showed that anchoring took place later in the recall method for the temporal and reductive treatment groups, but later in the recognition treatment for the additive groups. These results might imply a differential task-learning effect apart from any schema retention or anchoring effect.

Five-year olds. The four methods of introducing interferences differed at the .01 level of significance. As with the six-year old group, the irrelevant interferences produced the greatest number of errors. Almost without exception the sequential modifications were responded to on the criterion frame as a sequence in the recognition treatment, suggesting the introduction of a temporal response set in this type of modification. The irrelevant interference was met with almost complete success in the recognition treatment by all Ss. Neither of these two results occurred in the recall treatment. Under conditions of recall in the sequential modifications S generally provided a response that indicated a temporal shift from frame one to one of the later frames, most prominently one of the last frames to be seen, giving weight to Piaget's notion that very young children are perceptive bound. In both additive and reductive treatments, the preponderant response was indicative that S called not the original frame, but rather a mutation of it, usually one of the subsequent frames.

While, in general, recognition provided greater success

than recall, this was not consistently the case. For temporal sequencing Ss did better when asked to recall the original frame than when faced with the actual frame and asked to recognize it. Conditions of stimulus addition and reduction produced consistent results favoring recognition over recall, but the irrelevant interferences were met with success under both conditions. Further, while white Ss did better overall, blacks produced as many successful responses as whites under the recognition condition. The whites' advantage rested almost completely in their facility to recall the original stimulus after interference more accurately than the black Ss.

The results on the anchoring of five-year olds paralled those of the six-year olds with respect to the three types of interferences looked at. Again the temporal sequencing produced the earliest awareness that a set was being introduced. The reductive treatment produced anchors furthest through the set. The interesting effect of the anchor became clear in the five-year old group, more so than with either the four- or six-year old groups. A tendency was evident that when an S anchored in any of the three interference frames, when he was asked the criterion question, and if his answer was wrong, his response was based in the anchor frame, not in the original. An apparent shifting of the original schema seemed to be taking place. Unfortuately, this shifting was not noticed until it was too late to study it experimentally and is reported here as an observation, not a result of directed research into any phenomen of this nature.

Four-year olds. The four methods of introducing inferences were examined by use of a chi square analysis. Differences were found to be significant beyond the .01 level. Successes for various treatments were immediately evident with only the most superficial examination of the contingency table. As with the five and six-year old groups the irrelevant interference caused the least amount of retroactive inhibition. Again the temporal sequencing treatment produced the greatest amount of retroactive inhibition. The difference in these two treatmens was of such magnitude that little doubt could remain that the type of interference was a major factor. Nearly four times as many successes occurred when the interferences were unrelated to the original stimulus. As opposed to the temporal sequencing interference treatment. The other two treatments also produced more successes than the temporal sequencing treatment although not as many as the irrelevant treatment. In order of magnitude of successes the treatments were: 1 - irrelevant, 2 - additive, 3 - reductive, 4 - sequential.

Interestingly when the performance of Black four-year olds was compared with that of white four-year olds,

neither group showed any advantage in total successes or in successes within any treatment combination. Further, no difference was found in recall and the recognition conditions for determining schema retention. While a difference in the Blacks and whites showed up with the five-year old group this racial advantage in favor of the white was noticeably absent in the pre-schoolers.

When the data were examined to see when anchoring took place it was found that with this group anchoring took place later under the temporal regardless of any other type of treatment combination. In general, it was found that the original stimulus was lost completely as an anchor for subsequent presentations with the predominant response being based in the perception, that is to say, that overwhelmingly anchoring came either late or not at all. With this group it was found that almost never was the second or third modification found to be the anchor and that anchoring did not take a consistent pattern with any treatment combination. With some subjects who were noticeably successful, an immediate anchoring took place; with most no anchoring at all took place.The remainder anchoring took place near the end of the set. The implication here is that perhaps anchoring may have a threshold in the developmental pattern, at least with these type of stimuli.

Conclusion

Piaget's thesis has been that a schema which cannot be broughtto bear upon command is not a schema at all; that is if one does not retain for use the mental image then the mental image has never been truly conceptualized. The question posed by this study is centered around the idea that Piaget's notion may in fact be the question. It is maintained here that a schema can indeed be attained but that the nature of the types of interferences that present themselves to the learner may indeed affect the determination of whether this schema has been retained. The data obtained in the current study suggest that a schema may indeed be attained but that subsequent modifications of that schema may cause the schema to undergo a transformation which is directly related to the nature of the modifications. To demonstrate what is meant, let us look at the nature of the responses to the bus sequence. Under the temporal sequencing when the original stimulus was represented rather than recognize this re-presentation as the original stimulus children generally responded with a statement like, "Now he's off the bus and waiting for another bus." They did not recognize often times after

being told that they were looking at the same drawing that they started with. The sequencing drew them into a response set of such a nature that by the time the fifth frame of a five frame set was presented, the students were responding in a temporally oriented response mode rather than in a manner directly related to the stimulus placed before them. They had completely lost, in many cases, the schema they had started with and replaced it with a schema interpretively different and temporally relocated. This new schema could be easily recalled, recognized, utilized several days and several weeks after presentation but was not, in most cases, conceptualized in the same manner as the original schema. In brief, the original schema had been taken away and replaced with another. This finding is in keeping with what Piaget suggests in that the perception did not stand up under transformation, at least under conditions of recognition. Under conditions of recall the perception behaved more like a conception.

By contrast, when the types of interferences were totally unrelated to the original perception, the perception was retained. Without exception children of each of the age levels could recognize and recall the original stimulus after interference with non-relevant materials. The implication here is that the perception must remain a perception until it is exercised if Piaget's notion is correct. But for Piaget's notion to be correct one must ignore those types of activities which may impinge upon the retention of this perception. It would seem that the more relevant the type of interferences that clutter the actual perception the more likely it is that the conception (and by the same reasoning the more irrelevant the interferences the more likely a perception) is to be retained and come to be called a conception or a schema or a mental image or a construction.

To put this into some perspective take the situation in a primary classroom. The child is being taught to read. We teach him the word "sing." We write it down for him; we say it for him ; he learns the shape of the word; he learns the sound of the phonemes; he can recognize the word in and out of context; he can recall the word in and out of context. We test him on it. We find he does indeed know the word sing. So we teach him sang; go through the same steps as before and now we find that he has a conceptualization as best we can measure it of sang. We move on to sung; repeat the same process, and we find that he can learn sung because he has two schemas, sing and sang to operate from. Finally we are going to teach him song, and he learns song the same way he learned sing, sang, and sung.

So we go back to check him out, and we find that he does indeed know song and he knows sang but he has lost sing; and we have to teach him that again using as our basal schema one of the modifications of sing because one of these modifications, that is, sung, sang, or song has supplanted the original schema, sing. We must teach him sing all over again not because he did not have the schema in the first place, but he had it insecurely and we took it away from him. We took it away through successively interfearing with the schema with relevant modifications, such that the schema, tenuously held, is confirmed in a modified form. It can be relearned in its original form but more than likely as consequential modification.

Because of the sampling used in this study no attempt is being made to define specific models for learning. Clearly any comments as to how children learn are restricted to populations similar to the sampled population. It may well be that with middle class and upper class European children that the behaviors observed with these samples are unrepresentative. Some factors of deprivation, some imbalance in early development, perhaps a lack in early training may cause these poverty groups which were examined to behave differently from more advantaged groups. Still, it cannot be denied that some weight is given to the idea that learning can be hindered or facilitated by the respect that one pays to the developmental stages involved in mental image building. If an image is to be retained then it should be allowed to get intact. To attempt to build developmentally on an ill formed or uncompletely formed schema will bring about the removal of that schema and the supplanting of it by a different or modified version of it. Then the teacher becomes frustrated, the child becomes frustrated, society becomes frustrated because the child is expected to use a schema which has been systematically mutated.

Obviously a study of this nature can only be minimal in its impact, exploratory in its scope. Its purpose was to provide some insight into Piagetian psychology, to suggest an area for consideration in dealing with the deeply deprived and to provide a starting point for future research with a subset of our population which seems to be ignored in the classical, educational literature.

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APPENDIX A

TABLES	PAGE
1. Analysis of variance for comparing successes of conservation tasks for six year old whites	A 1
2. Analysis of variance for comparing successes of conservation tasks for six year old blacks	A 1
3. Analysis of variance for comparing anchoring of conservation tasks for six year old whites	A 2
4. Analysis of variance for comparing anchoring for six year old blacks	A 2
5. Analysis of variance for comparing latency of six year old whites	A 3
6. Analysis of variance for comparing latency of six year old blacks	A 3
7. Analysis of variance for comparing successes on conservation tasks for five year olds	A 4
8. Analysis of variance for anchoring on conservation tasks for five year olds	A 4
9. Contingency table for successes of four year olds on conservation tasks	A 5
10. Contingency table for anchoring of four year olds on conservation tasks	A 5

TABLE 1

ANALYSIS OF VARIANCE FOR COMPARING SUCCESSES OF CONSERVATION TASKS FOR SIX YEAR OLD WHITES

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	P
Modifications	93.01	3	31.00	11.74	.01
Criteria	15.72	1	15.72	5.95	.05
Interaction	27.37	3	9.12	3.45	.05
Within	148.26	56	2.64		
Total	284.36	63			

TABLE 2

ANALYSIS OF VARIANCE FOR COMPARING SUCCESSES OF CONSERVATION TASKS FOR SIX YEAR OLD BLACKS

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	P
Modifications	89.04	3	29.68	10.56	.01
Criteria	13.14	1	13.14	4.68	.05
Interaction	21.92	3	7.30	2.60	.05
Within	157.37	56	2.81		
Total	281.48	63			

TABLE 3

ANALYSIS OF VARIANCE FOR COMPARING ANCHORING OF CONSERVATION TASKS FOR SIX YEAR OLD WHITES

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	P
Modifications	640.23	2	320.11	20.93	.01
Criteria	121.11	1	121.11	7.92	.01
Interaction	247.33	2	123.66	8.08	.01
Within	642.58	42	15.29		
Total	1651.25	47			

TABLE 4

ANALYSIS OF VARIANCE FOR COMPARING ANCHORING OF CONSERVATION TASKS FOR SIX YEAR OLD BLACKS

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	P
Modifications	697.87	2	348.93	23.98	.01
Criteria	105.02	1	105.02	7.22	.05
Interaction	238.29	2	119.14	8.19	.01
Within	611.12	12	14.55		
Total	1652.31	47			

TABLE 5

ANALYSIS OF VARIANCE FOR COMPARING LATENCY OF CONSERVATION TASKS FOR SIX YEAR OLD WHITES

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	P
Modifications	1661.22	3	553.74	3.6	.05
Criteria	256.77	1	256.77	1.7	NS
Interaction	1087.50	3	362.50	2.4	NS
Within	8458.24	56	151.04		
Total	11463.73	63			

TABLE 6

ANALYSIS OF VARIANCE FOR COMPARING LATENCY OF CONSERVATION TASKS FOR SIX YEAR OLD BLACKS

Source of Variance	Sums of Squares	Degrees of Freedom	Mean Squares	F	P
Modifications	1427.92	3	475.97	2.97	.05
Criteria	213.89	1	213.89	1.33	NS
Interaction	1330.29	3	443.43	2.77	.05<p<.10
Within	8974.62	56	160.26		
Total	11946.73	63			

TABLE 7

ANALYSIS OF VARIANCE COMPARING SUCCESSES ON CONSERVATION TASKS FOR FIVE YEAR OLDS

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	P
A Modifications	71.80	3	23.93	5.93	.01
B Criteria	50.25	1	50.25	12.46	.01
C Interaction	43.89	1	43.89	10.89	.01
AxB	47.72	3	15.91	3.94	.01
AxC	21.20	3	7.07	1.75	NS
BxC	20.52	1	20.52	5.09	.05
AxBxC	24.52	3	8.17	2.02	NS
Error	451.42	112	4.03		
Total	565.48	127			

TABLE 8

ANALYSIS OF VARIANCE FOR ANCHORING ON CONSERVATION TASKS FOR FIVE YEAR OLDS

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	P
A Modifications	340.44	2	170.22	8.68	.01
B Criteria	48.43	1	48.43	2.47	NS
C Interaction	170.01	1	170.01	8.67	.01
AxB	70.17	2	35.08	1.79	NS
AxC	422.00	2	211.00	10.77	.01
BxC	34.13	1	34.13	1.74	NS
AxBxC	62.35	2	31.17	1.59	NS
Error	1646.33	84	19.59		
Total	2793.86	95			

TABLE 9

Chi Square Contingency Table for Successes of Four Year Olds on Conservation Tasks

	temp.	addit.	reduc.	irrel.	
recog.	5	24	13	32	blacks
recall	12	20	14	30	
recog.	7	22	16	34	whites
recall	10	18	14	31	

TABLE 10

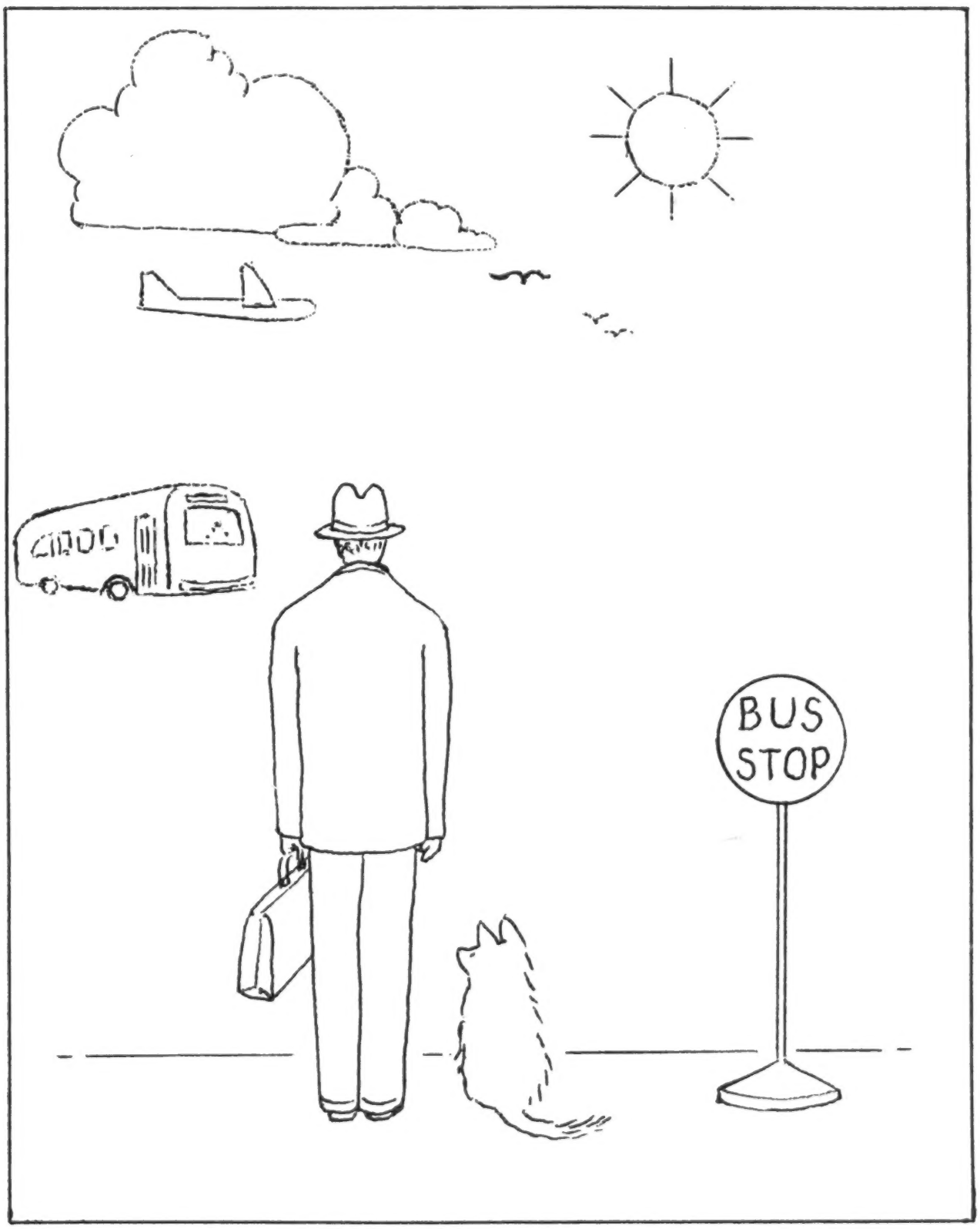
Chi Square Contingency Table for Comparing Anchoring of Four Year Olds

	temp.	addit.	reduc.	irrel.	
recog.	30	28	23		blacks
recall	31	27	25		
recog.	31	26	23		whites
recall	30	28	24		

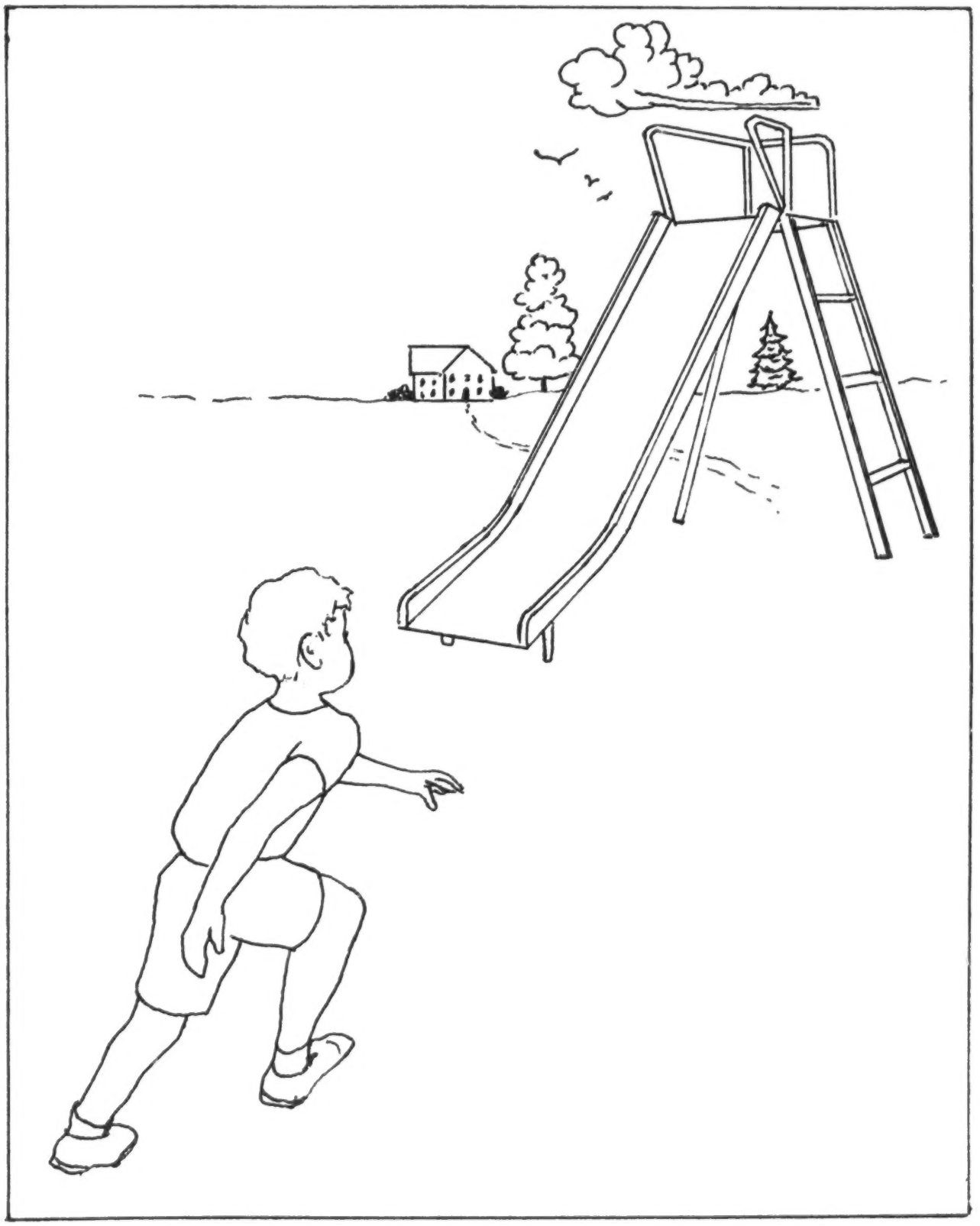
APPENDIX B

PLATES	PAGE
Original scenes for testing	B 1-5
Examples of testing interferences	
Sequential (temporal) interferences	B 6
Additive interferences	B 9
Reductive interferences	B 12
Irrelevant interferences	B 15

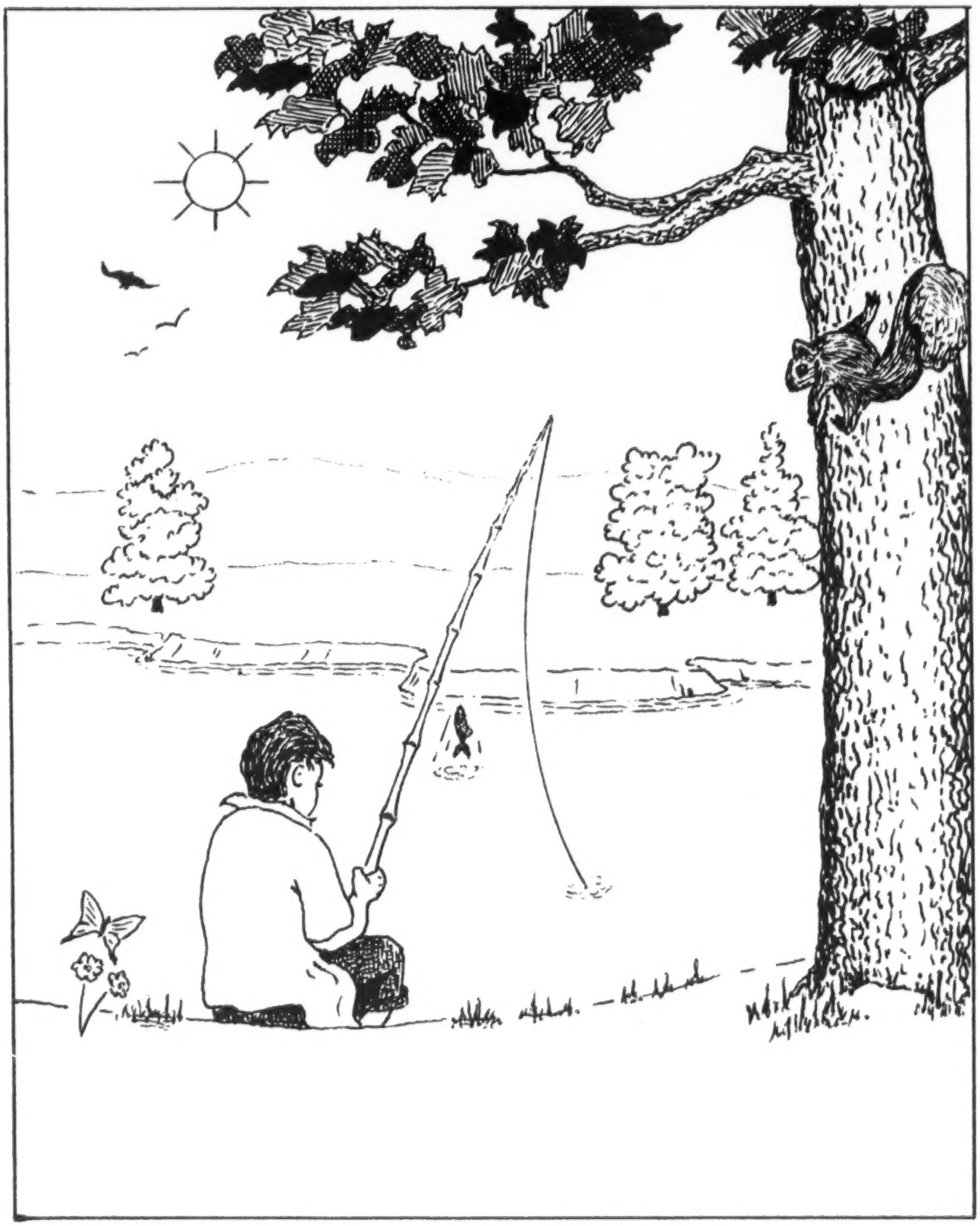
Original Frame for Bus Sequence



Original Frame for Playground Sequence

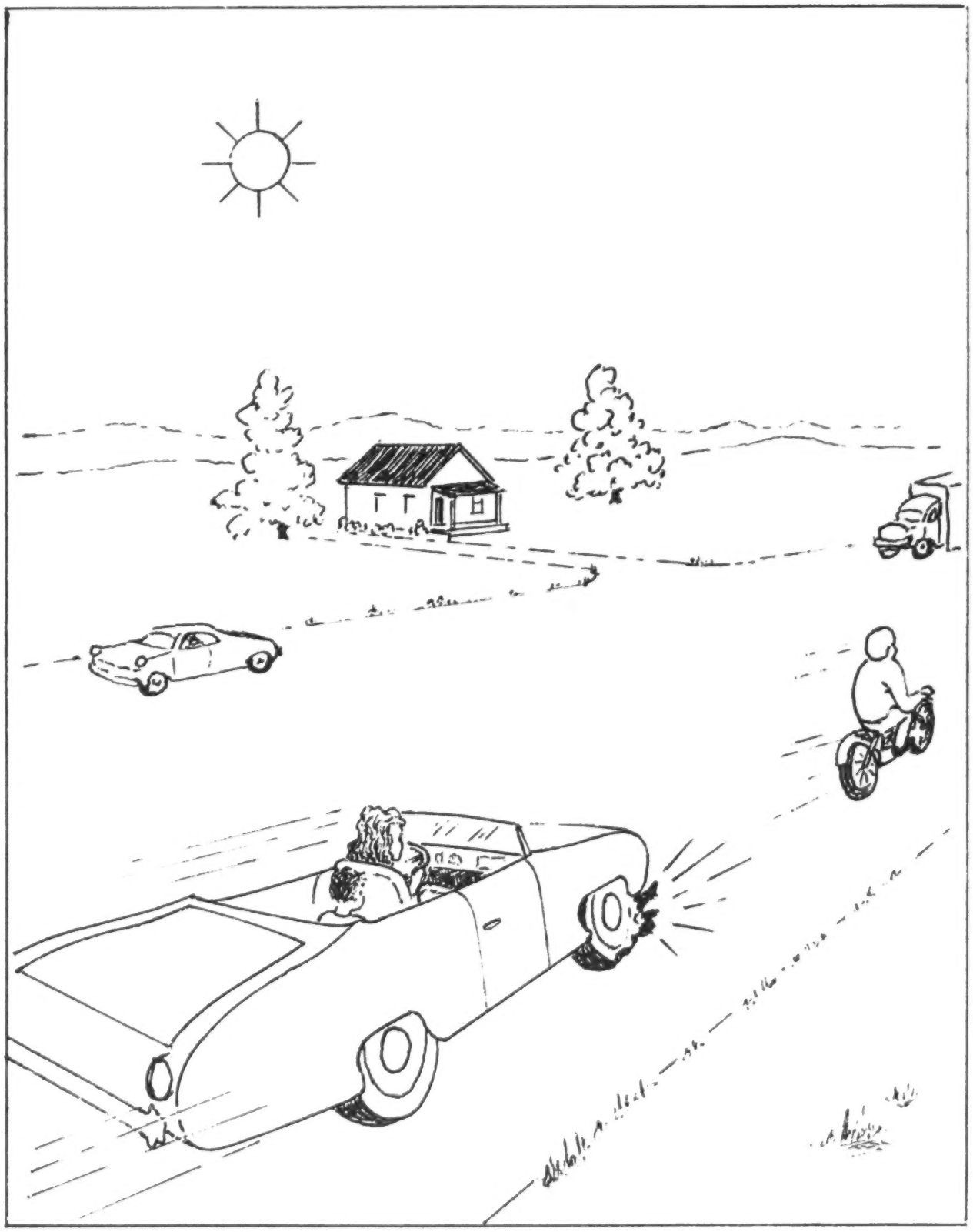


Original Frame for Fishing Sequence

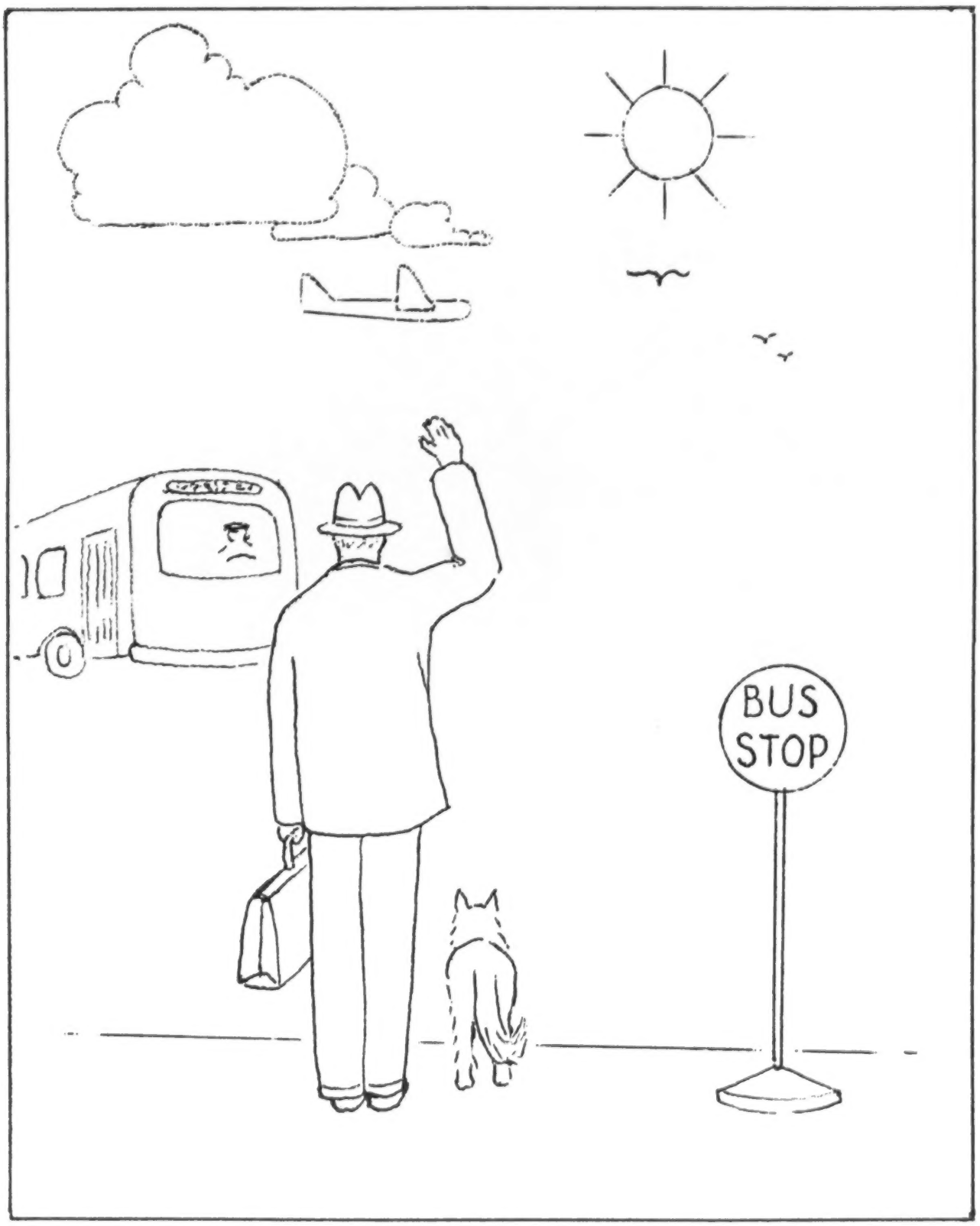


Original Frame for Girl Awakening Sequence

Original Frame for Motorcycle Sequence



Bus sequence: temporal modification, frame 2



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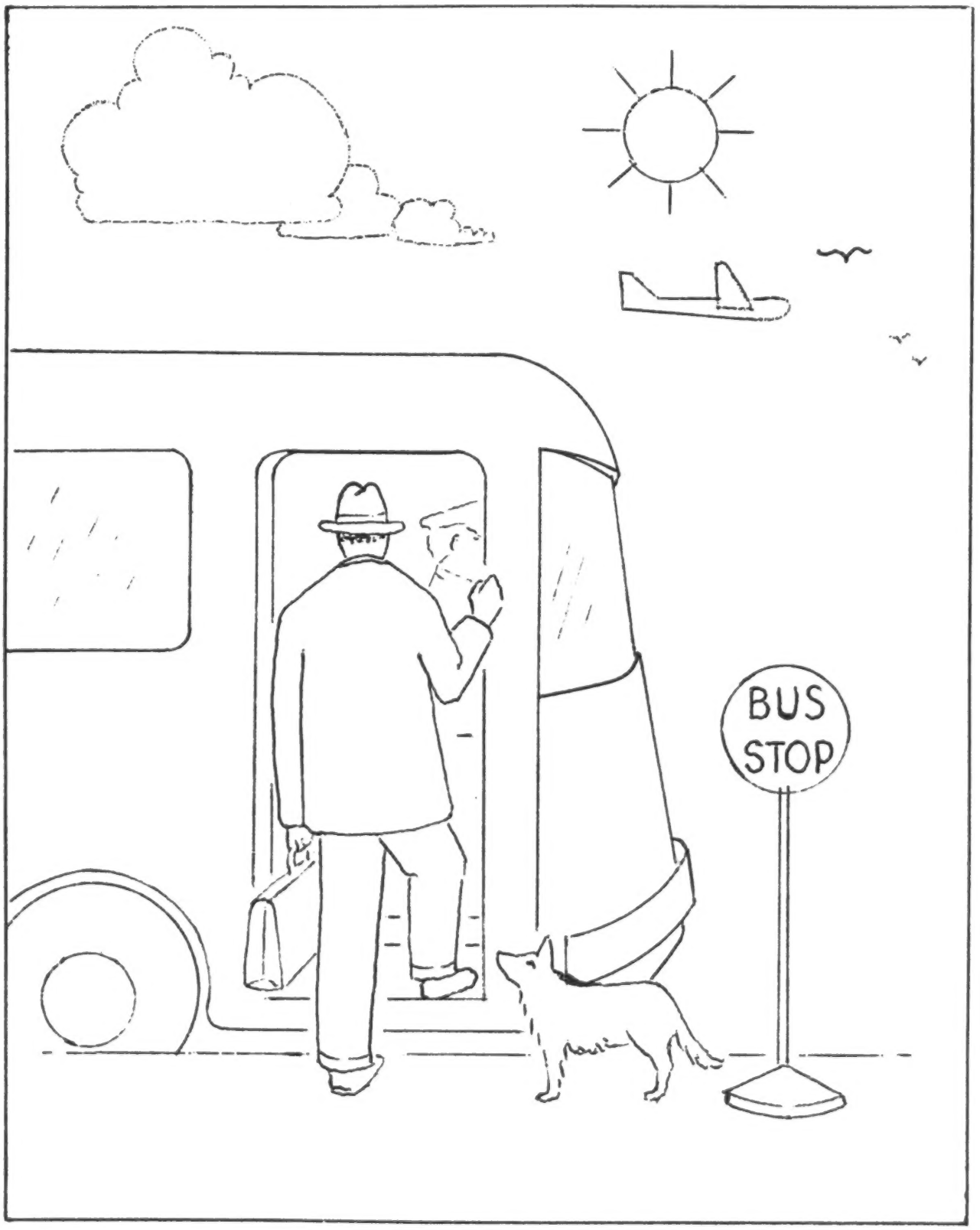

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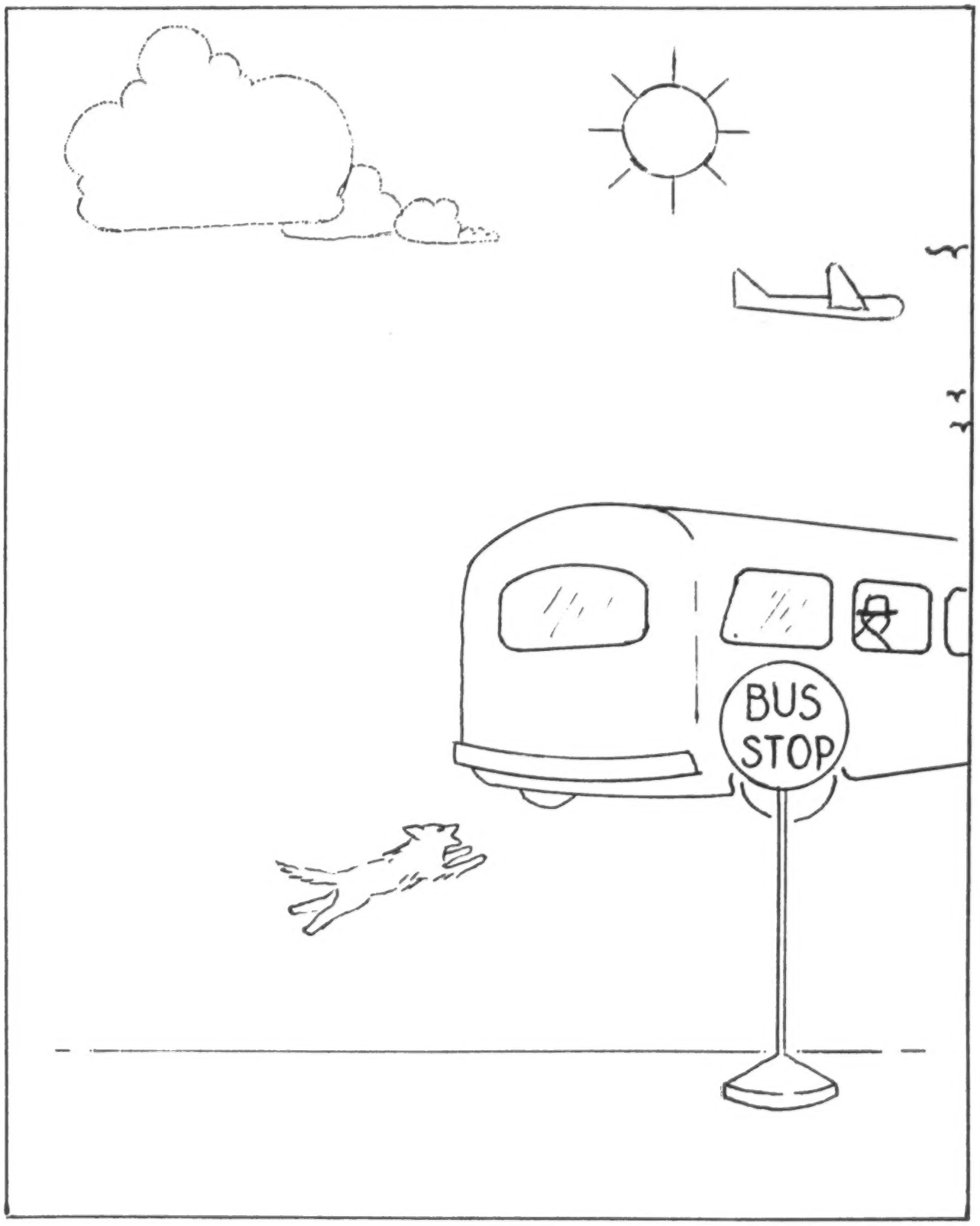

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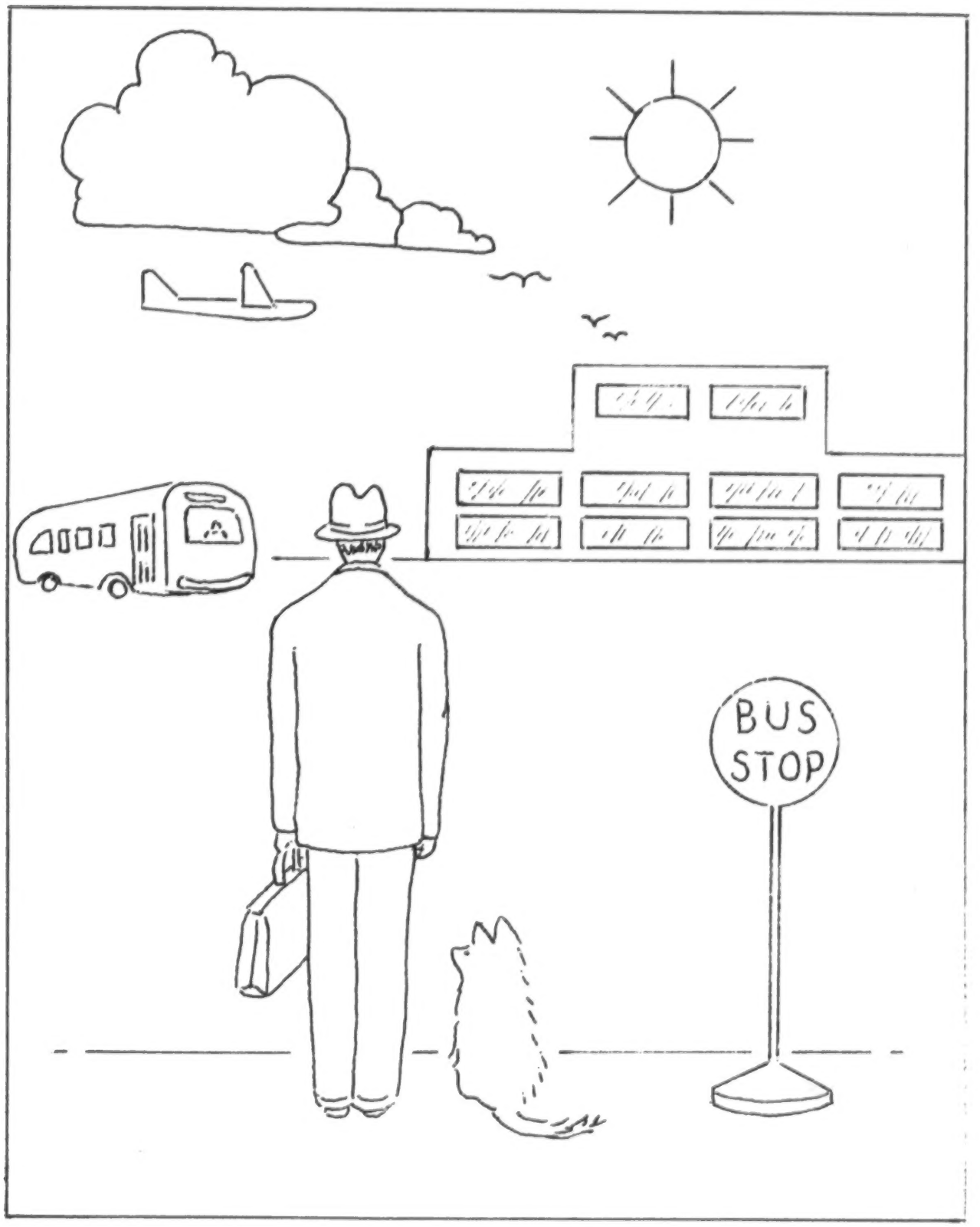

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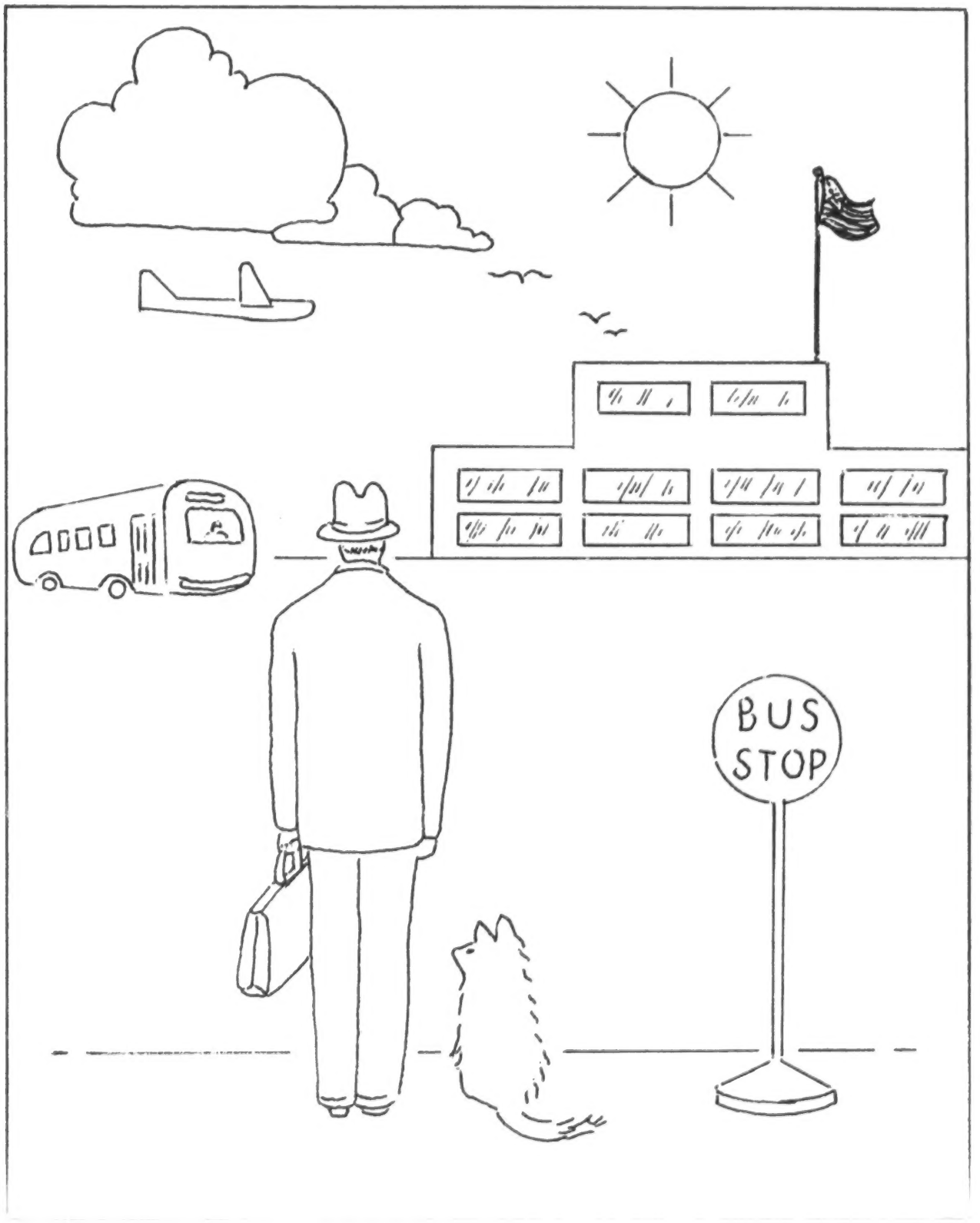

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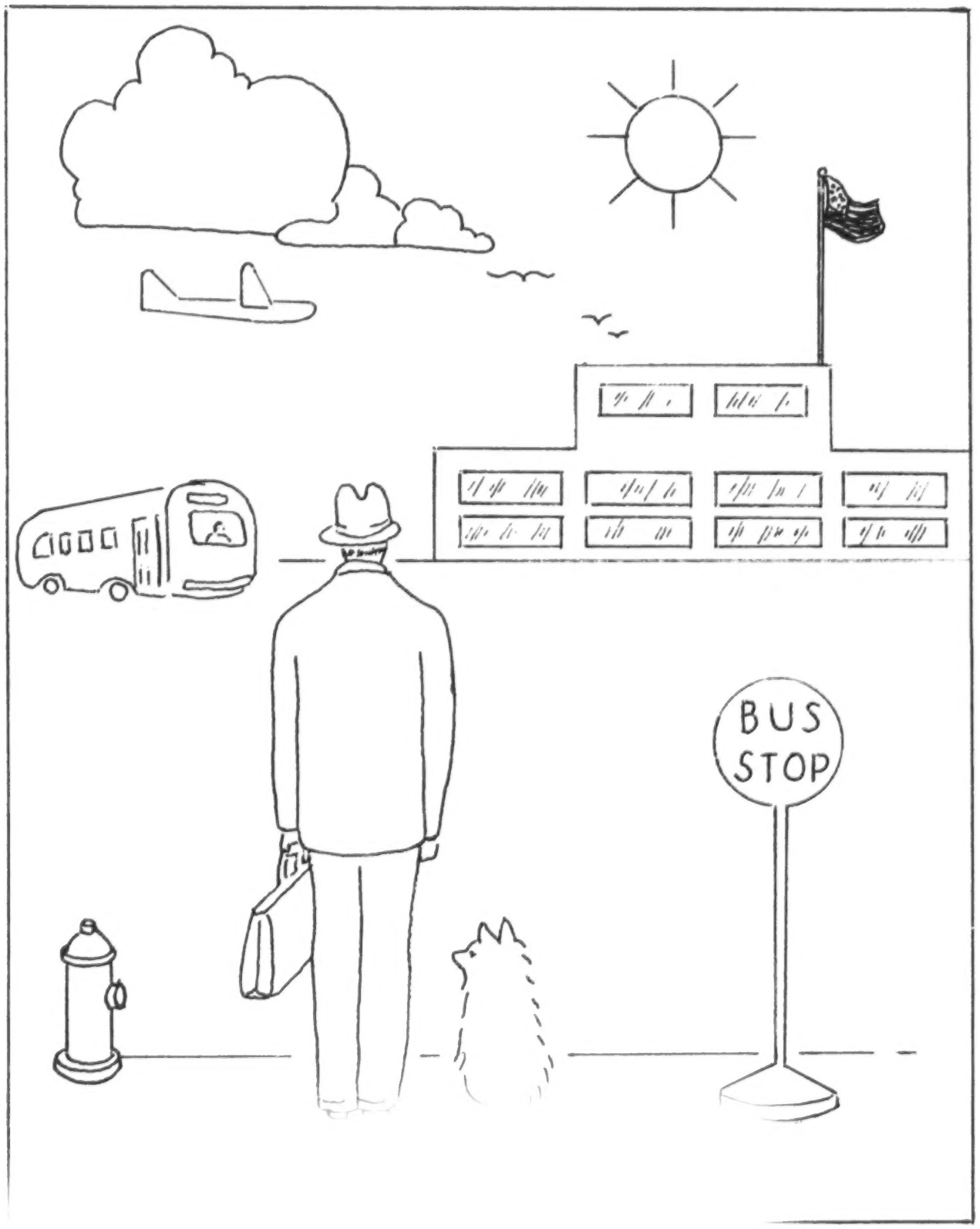

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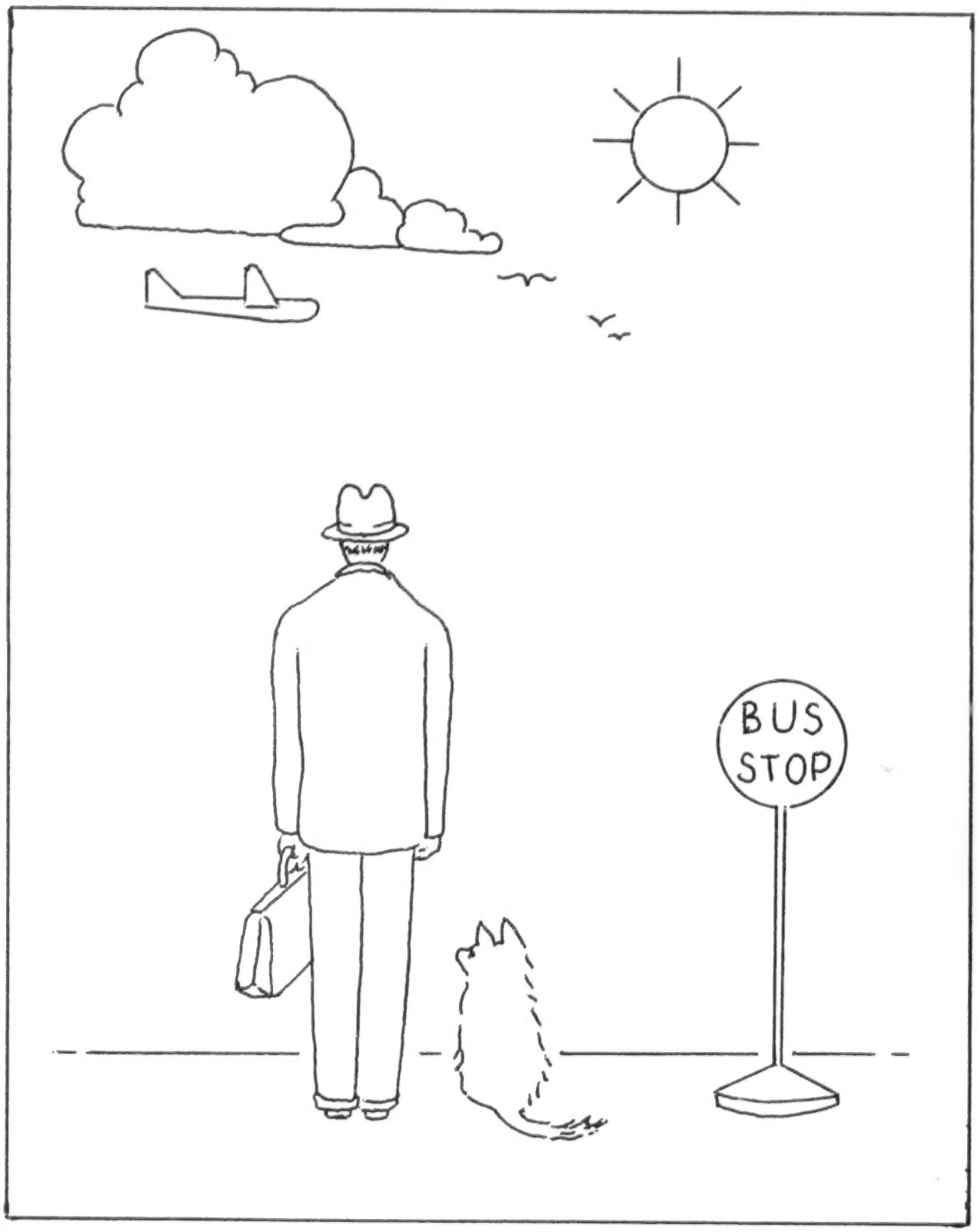

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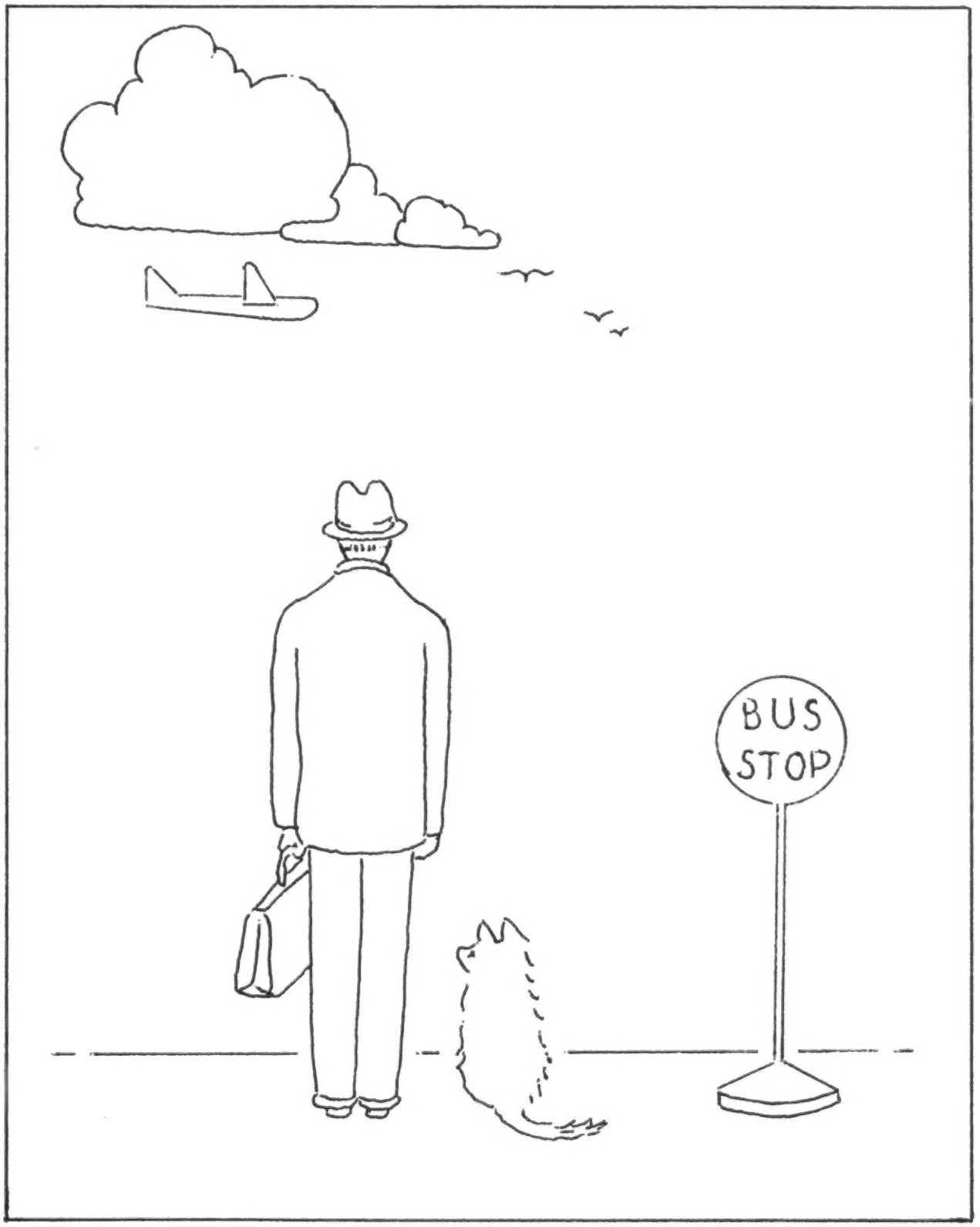

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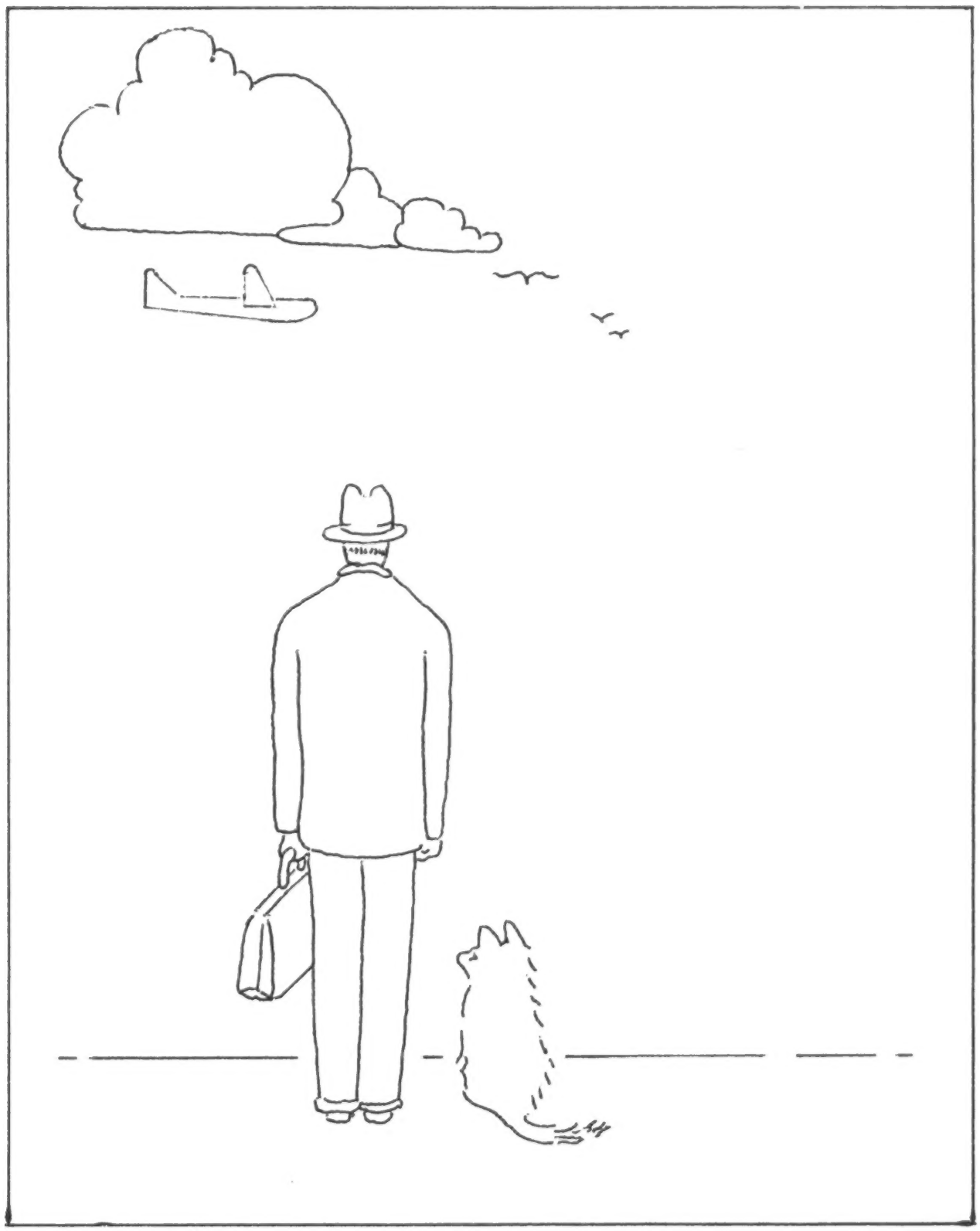

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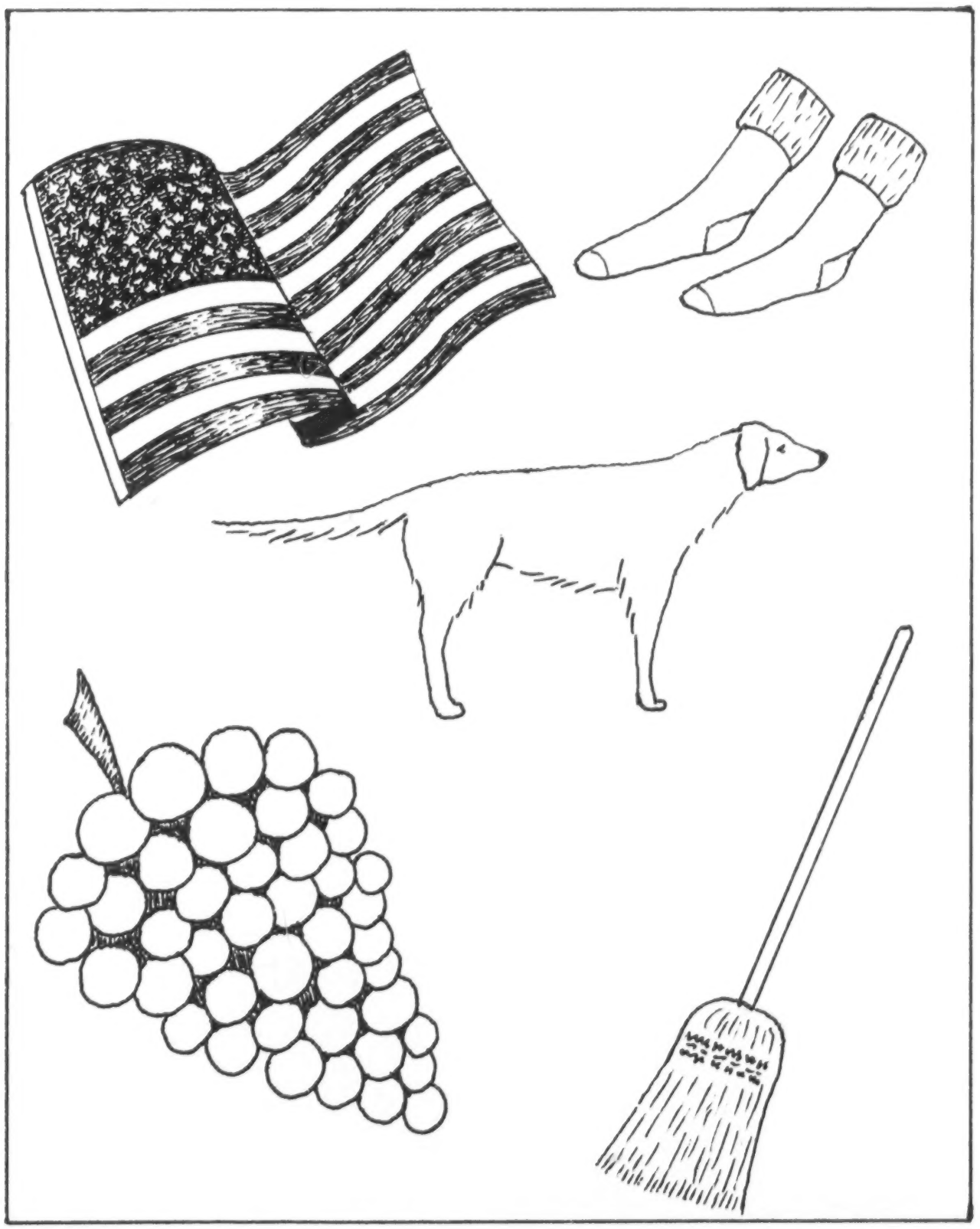
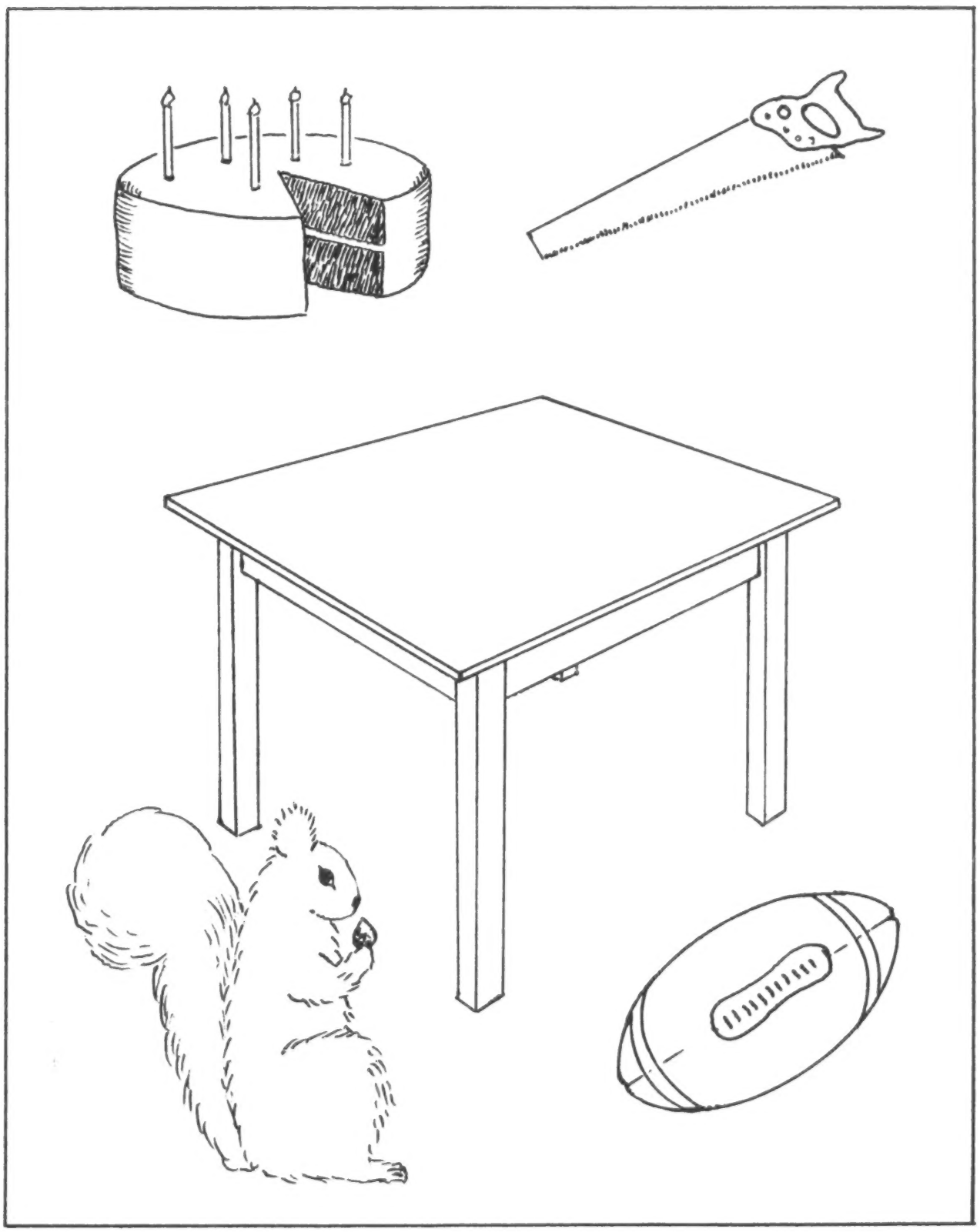


Bus sequence: irrelevant modification, frame 3



Bus sequence: irrelevant modification, frame 4